IJLST

ISSN: 0974-5335
IJLST (2012), 5(4):24-28

Appropriate Agronomy Practices Adoptable for Climate Change

A. K. Gana
National Cereals Research Institute, P.M.B. 8, Bida, Niger State, NIGERIA
andrewgana2@yahoo.com

ABSTRACT:
Climate Change is an issue which has turned out to be one of the major challenges of our time as it is gradually attaining a catastrophic dimension globally, exacting considerable tolls on nations' economies. The Agricultural sector is more vulnerable as its key natural resources/inputs such as land and water are usually the most affected. At the level of farms, adjustments may include proper land preparation where planted seeds are in contact with the soil moisture so they will germinate to become established quickly to escape drought as a result of reduction in rainfall duration. Removal of weeds is necessary because they successfully compete with crops for moisture, nutrients and light. In addition, some weeds secrete chemicals from their roots into the soil that inhibit crop seeds from germinating thereby making germination and establishment difficult in climate change condition .The incorporation of crop residues and fertilizer materials into the soil, when ploughed into the soil, helps build up organic matter and nutrients for the crop thereby leading to reduction of high infiltration of limited water through either rainfall or irrigation and also reducing excessive evaporation of water from the soil. Also, ploughing breaks the soil crust and hardpans, improving water penetration and aeration. Other management practices such as contouring, strip planting, cover cropping, alley cropping, reduced tillage, terracing and leaving some crop residue on the land help to eliminate or minimize the loss of water from soil and wind erosion. Introduction of farming systems such as intercropping , crop rotation and agro forestry all these will enable judicious use of the limited natural resources in the soil and reduction in evapotranspiration.

Key words: - Climate change, soil, water, agriculture, adoptable farm practices or technologies

INTRODUCTION

The climate change can be defined as a change in the statistical properties of the climate system when considered over long periods of time, regardless of cause [1]. The term sometimes is used to refer specifically to climate change caused by human activity, as opposed to changes in climate that may have resulted as part of earth's natural processes [2]. The term climate change today is synonymous with anthropogenic global warming.

Climate Change is an issue which has turned out to be one of the major challenges of our time as it is gradually attaining a catastrophic dimension globally, exacting considerable tolls on nations' economies. The Agricultural sector is more vulnerable as its key natural resources/inputs such as land and water are usually the most affected. Some changes in climate may result in increased precipitation and warmth, resulting in improved plant growth and the subsequent sequestration of airborne CO_2. Larger, faster or more radical changes, however, may result in vegetation stress, rapid plant loss and desertification in certain circumstances.

Human societies over the ages have depleted natural resources and degraded their local environments. Populations have also modified their local climates by cutting down trees or building cities. It is now apparent that human activities are perturbing the climate system at the global scale.

Impacts on and challenges to agriculture:
These include:-Changes in start/end of growing season leading to lower yields, reduced water supply for crop growth and less potential for irrigation as a result of drought. Increased in the evapo-transpiration from plants due to temperature rise thereby, leading to inadequate soil moisture resulting in failure of crop to reach maturity. Reduced crop yield subsequently, leading to food shortage which has its health implications. Loss of arable land and reduced of soil fertility following soil degradation as a result of drought, desertification, sea level rise and erosion. Increase in Amyclose content of grains like rice due to elevated carbon dioxide (CO2) which in turn lowers the constitution of iron and zinc that are important for human nutrients.

Decrease in protein content of grain as a result of combined effect of increased temperature and CO2. Increase in the multiplication of diseases, and pests following humid and hot conditions. Poor egg production, reduced milk production and high incidence of pest and diseases due to increased in temperature leading to migration of cold-loving animal, and reduced fishing activities due to drought.

This paper therefore, presents research results or technologies which when adopted by the farmers will provides solution to climate change. However, some of the technologies may be location specific based on the type of climate changes being experienced.

MATERIALS AND METHODS

This review paper is derived from several experiments including long and short terms carried out at the upland sugarcane experimental field of the National Cereals Research Institute Farm, Badeggi (lat. 9°45'N, long. 0.6°07'E; 70.5 meters above sea level) in the Southern Guinea Savannah ecological zone of Nigeria and other research scientists' work across the world. The soil of

the experimental site of the National Cereals Research Institute Farm, Badeggi had been classified as ultisol and sandy loam in texture with a bulk density of 1.459g cm^{-3} [3]. The area has an average annual rainfall of 1124mm and mean temperature of 23.0° - 33.0°C.

DISCUSSION

Adoptable technologies against climate change

Proper land preparation

Preparing the land for crop production serves many purposes, including a) the creation of a good seedbed, where planted seeds are in contact with the soil moisture so they will germinate to become established quickly to escape drought as a result of reduction in rainfall duration. b) Weed control. Removal of weeds is necessary because they successfully compete with crops for moisture, nutrients and light. In addition, some weeds secrete chemicals from their roots into the soil that inhibit crop seeds from germinating thereby making germination and establishment difficult in climate change condition [5]. c) The incorporation of crop residues and fertilizer materials into the soil, when plowed into the soil, helps buildup organic matter and nutrients for the crop thereby reduction high infiltration of limited water through either rainfall or irrigation and also reducing excessive evaporation of water from the soil [5]. d) Also, ploughing breaks the soil crust and hardpans, improving water penetration and aeration. e) Because of the possible damage to soil structure from overworking the soil, one modern approach to soil conservation is to use only as much tillage as is required to produce a good crop. The kind and amount of tillage is determined according to crop, soil and field conditions. No one set of guiding standards is appropriate for all situations. Tillage must be done in a way that will assure adequate protection of soil and water resources. A good soil surface will prevent crust formation and allow rapid rainfall penetration and reduce runoff of the limited water.

Planting

Before planting seeds, be sure the soil is thoroughly worked and free of clumps. This will ensure the necessary contact between seeds and soil. Plant at the proper depth for immediate germination. Proper spacing reduces overcrowding in times of limited water and poor soil. Save some seed for planting later in case of unforeseen conditions resulting into poor germination.

FARMING SYSTEM APPROACH

Crop rotation

Crop rotation consists of growing different crops in succession on the same land, rather than utilizing a one-crop system or a haphazard change of crops. Because frequent tillage hastens the oxidative loss of organic matter, rotations usually include one or more crops that require little or no tillage. Goals are to keep the soil surface covered with a growing crop for most of the year to reduce excessive evaporation of water.

Key elements of rotations include the breaking of disease and pest cycles and the inclusion of soil building cover crops or cropped fallow periods. By selecting effective cover crops or perennial crops farmers can maintain or increase soil organic matter content and nutrient availability during the periods when cash crops are not grown.

In the rotation system, crops are alternated on the basis of the amounts and types of organic matter that each crop returns to the soil. Deep-root penetration on the part of certain leguminous crops, such as alfalfa, provides better drainage as a result of the channels left after the roots decay.

Intercropping

Intercropping refers to growing more than one crop in the same land area in rows of definite proportion and pattern [6]. The system uses the practice of sowing a fast growing crop with a slow growing crop, so that the fast growing crop is harvested before the slow growing crop starts to mature. The most common goal of intercropping is to produce a greater yield on a given piece of land by making use of resources that would otherwise not be utilized by a single crop[6]. The system is a solution to the land scarcity that is arising as a result of sporadic increase in human population and climate change effect across the world. Through this system, judicious use of soil nutrient could be achieved as nutrients could be taken from different soil depths. When a legume is intercropped with a cereal, it provides part of the needed nitrogen through fixation to cereals [7].

Careful planning is required for the practice of intercropping in sugarcane. This includes taking into account the soil, climate, crops, and varieties. It is particularly important not to have crops competing with each other for physical space, nutrients, water, or sunlight. Examples of intercropping strategies are planting a deep-rooted crop with a shallow-rooted crop, or planting a tall crop with a shorter crop that requires partial shade. When crops are carefully selected, other agronomic benefits are also achieved. Lodging-prone plants (those that are prone to tip over in wind or heavy rain) may be given structural support by their companion crop. In theory, sugarcane is a crop that offers unique possibilities for intercropping. Sugarcane characteristically is widely spaced, initially slow growing, long duration and one time income generating crop, lends ample scope for intercropping with short duration, high value and mid-season income

generating crops for nutrition and economic security especially of small and marginal cane growers[7].

Alley cropping

Alley cropping is the planting of trees or shrubs in two or more sets of single or multiple rows with agronomic, horticultural, or forage crops cultivated in the alleys between the rows of woody plants.

Alley cropping is used to enhance or diversify farm products, reduce surface water runoff and erosion, improve utilization of nutrients, reduce wind erosion, modify the microclimate for improved crop production, improve wildlife habitat, and enhance the aesthetics of the area.

Trees or shrubs are generally planted in a single- or multiple-rows.The spacing between sets is determined by the primary purpose of the alley cropping and the agronomic, horticultural, or forage crop grown. Woody plants are typically selected for their potential value for wood, nut, or fruit crops and/or for the benefits they can provide to the crops grown in the alleys. Common tree species are black walnut, pecan, green ash, shear butter, and northern red oak. There are many other compatible species, depending upon region of the country, value, and markets.

Cultivation of hardy crops

Watermelons (*Citrullus vulgaris*), egunsi melon *(Citrullus lanatus (*thumb) manf.) bambara ground nut, acha *Digitaria exiles*, are grown throughout the tropics and subtropics in the hot drier areas with abundant sunshine under marginal soil. These are ready for harvesting between 3- 5 months after planting [6].

Cover crops

Cover crops include annual, biennial, or perennial herbaceous plants grown in pure or mixed stands. Cover crops provide soil cover and can help loosen compacted soil through the growth of roots. Cover crops serve as live mulch to the soil against direct contact of the sun with the soil and thereby reducing excessive evaporation; maintain favourable condition for the activities of micro organisms. They also help to suppress many annual weeds which will compete with the crop for limited moisture and nutrients. Other organic mulches, such as straw and chipped brush, add organic matter, whereas synthetic clear or colored plastic films and weed barrier fabrics do not. All mulches are very effective in preventing soil erosion [8]. Good sources of mulch include clean wheat straw, rye straw, alfalfa, vetch, crimson clover, sorghum, hay grazer, lawn clippings etc.

Organic farming

These are natural fertilizers which supply nutrients for crop growth. Organic fertilizer serves as food for soil micro-organisms and also helps to improve soil structure. A recommendation for maintaining soil fertility is to add 2 to 4 inches of organic matter per year and maintain the proper pH by adding lime based on test results. Farmers in Nigeria commonly apply cattle dung through broadcasting of cattle dung on the soil surface [7]. According to [7], this is as a result of this method being cheap, easy, simple and fast to apply without the need of any special equipment. Women who cultivate chewing sugarcane find it too very cheap and easy especially nursing mothers and those with pregnancy. Cattle manure is an alternative source of inorganic fertilizer and has been reported as a good soil amendment

WATER MANAGEMENT APPROACH

Water re -use

The re-use of water on agricultural lands is a positive technology to be adopted by farmers as a solution to climate change especially where there is no enough rainfall [9].This is advantageous because it does not only provides the required crop water but also contains some valuable plant nutrients[10]. The work of researchers such as [11], indicate increased yield of sorghum crop as a result of using sewage effluent for its irrigation. The environmental pollution and health hazards posed by effluent irrigation are taken into account by its treatment and probably appreciate crop selection for irrigation. Result showed that the salinity sodium hazard and bacterial concentration of the effluent irrigation system and that of the tap water were brought into acceptable level for application [12].

Flooding regimes

The NCRI Badeggi rice irrigation scheme in Nigeria observed that seasonal stream flow is not sufficient to meet irrigation and domestic water needs. Water was managed for rice production through flooding regimes at different intervals. The results showed that rather than from transplanting to harvest maintaining saturation of the flood, flooding water at 40 days after transplanting (DAP), 60 and 90DAT, flooding for 90DAT gave good yield comparable to flooding throughout the growing period of the crop [13]. Through flooding regimes, according to them double cropping of rice could be possible.

Critical water potential

There is currently no recommendation on irrigation schedule to disseminate to papaya growers [14]. Consequently, local papaya growers hardly practice irrigation. But to fully exploit the expanding market, papaya growers need to adapt irrigation. At University of Abeokuta, Nigeria, the critical soil water potential for the papaya mixture okra and papaya for effective water management have been studied. The critical soil water potential for the mixture is considered to be -0.20mpa. Thus, a papaya okra mixture requires

irrigation when ever soil water potential exceeds -0.20mpa. With this, water was economically managed using irrigation schedule at -0.20mpa for two field crops okra and papaya with optimums yield on sandy loam which would have been very difficult because of high percolation in sandy loam leading to wastage of water. This has also help in maximizing the land use.

Controlled drainage

This is a practice that allows farmers to control drainage out flows, storing water in the soil profile for use by the crop and reducing loses from the system. Drainage flows are managed so that the drainage flow occurs only after the ground water level in a field has risen to the point where drainage is needed to prevent crop damage, or to provide salt leaching irrigation applications can the relatively good quality water that is save becomes available for use by downstream irrigators. It improves crop yield, increased insurance against crop losses due to water shortage. Maintain soil nitrate and phosphate levels so that the fertility is not degraded in high irrigation or high rainfall areas. It reduce nitrate and phosphate thus be reduced, and losses to downstream water bodies. It is particularly applicable to areas that experience periodic water shortage, and suffer from limits to crop production and high costs for water application [15].

CONCLUSION

Agriculture of any kind is strongly influenced by the availability of water. Climate change will modify rainfall, evaporation, runoff, and soil moisture storage. The occurrence of moisture stress during flowering, pollination, and grain-filling is harmful to most crops and particularly so to corn, soybeans, and wheat. Increased evaporation from the soil and accelerated transpiration in the plants themselves will cause a wide variety of adaptive actions to be taken to lessen or overcome adverse effects of climate change on agriculture. At the level of farms, adjustments may include the introduction of early- maturing crop varieties or species, switching cropping sequences, sowing earlier, adjusting timing of field operations, conserving soil moisture through appropriate tillage methods, and improving irrigation efficiency. Some options such as switching crop varieties may be inexpensive while others, such as introducing irrigation (especially high-efficiency, water-conserving technologies), involve major investments.

A major adaptive response will be the breeding of heat- and drought-resistant crop varieties by utilizing genetic resources that may be better adapted to new climatic and atmospheric conditions. Collections of such genetic resources are maintained in germ-plasm banks; these may be screened to find sources of resistance to changing diseases and insects, as well as tolerances to heat and water stress and better compatibility to new agricultural technologies. Crop varieties with a higher *harvest index* (the fraction of total plant matter that is marketable) will help to keep irrigated production efficient under conditions of reduced water supplies or enhanced demands. Genetic manipulation may also help to exploit the beneficial effects of CO_2 enhancement on crop growth and water use.

REFERENCES

[1] Houghton, John Theodore, ed (2001) Appendix I – Glossary". Climate change 2001: the scientific basis: contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK: Cambridge University Press. ISBN 0-521-80767-0. http://www.ipcc.ch/ipccreports/tar/wg1/518.htm.

[2] Watson, Eb; Harrison, Tm (2005) "Zircon thermometer reveals minimum melting conditions on earliest Earth". Science **308** (5723): 841–4. Bibcode 2005Sci...308...841W. Doi:10.1126/science.1110873. ISSN 0036-8075. PMID 15879213.

[3] Ayotade, K. A. Fagade, S. O. (1993) Wet land utilization for rice production in sub-saharan Africa. Proceedings of an International Conference on Wet Land Utilization held at Ibadan, Nigeria 4 - 8 Nov., 1993, pp. 25 – 26.

[4] Gana,A.K.., Ndarubu, A.A, Busari,L.D. (2006) Comparative study on the effectiveness of CGA 362 + Ametryne with the recommended conventional pre-emergence herbicides on weed control in sugarcane. International Journal of Sugar Tech .India 8(1):88-89.

[5] Gana, A.K.(2010) Water management for field crops. International Journal of Agricultura Tropica et Subtropica 43(2): 137-140.

[6] Gana,A.K., Busari, L. D. (2003) Intercropping study in sugarcane (Saccharum officinarum L.). International Journal of Sugar Tech...India 5(3):193-19.

[7] Gana, A.K. (2010) Agronomy of Sugarcane. Jude – Evans Books and Publications .93pp.

[8] Gana, A.K, Ogunremi,L.T. (2007) Effect of trash cane farming on weed control and yield of sugarcane. International Journal of Sugar Tech .India 9(4): 318-319.

[9] Gana, A.K. (2011) Cow dung: soil amendment agent for the sandy upland sugarcane ecology in Nigeria. Journal of Agricultural Technology Southeast Asia 7 (2): 497-505.

[10] Cogels, O. (2003) IPTRID's new partnership programme launched ISSUE (21): 2003 Oswu (1999) Efficient soil water use: the key to sustainable crop production in dry areas. andhra pradesh, india pp 49.

[11] Oswu (1999) Efficient soil water use: the key to sustainable crop production in dry areas. Andhra Pradesh, India pp 49.

[12] Okereke, K. D. (1998) Irrigation of melon crop using effluent water. Proceedings of 12th National Irrigation and Drainage Seminar on irrigation in sustainable Agriculture IAR/ABU Zaria, pp130.

[13] Saul, E., Bababe, B; Olaniyan, G. O, Misari, S. M. (1998) Irrigation water management in lowland rice production at Badeggi irrigation scheme.

ISSN: 0974-5335
IJLST (2012), 5(4):24-28

Proceedings of 12th National Irrigation and Drainage Seminar on irrigation in sustainable agriculture. IAR/ABU Zaria 14th - 15th April, 1998 pp14-17.

[14] Aiyeloagbe, I. O. O. Fawusi, M. O. A. (1998) Effect of irrigation on the performance of a papaya okra mixture. Proceedings of the 12th National Irrigation and Drainage Seminar on Irrigation in Sustainable Agriculture. IAR/ABU Zaria, 14th - 16th April, 1998.

[15] Abbott, C., Abbdel-Gawad, S. (2003) Controlled drainage to improve water use efficiency in Semi-Arid areas. ISSUE (21) : 2003.